HEAT EXCHANGER

BACKGROUND OF THE INVENTION

The present invention relates to a heat exchanger which is comprised of two or more heat exchangers having different usage.

Conventional heat exchangers used for vehicles include a heat exchanger which is comprised of two or more heat exchangers having different operations.

For example, Japanese Patent Application Publication No. 10-306994 discloses a heat exchanger which has a radiator core section for an engine and a condenser core section for a vehicle air conditioner configured integrally. Japanese Patent Application Publication No. 10-253276 has paid attention to the ratio between the width of fins and the number of louvers, which are disposed between tubes of a condenser core section and a radiator core section. The heat exchanger is made up so that a heat exchanger requiring a small amount of radiation has a lower ratio between the fin width and the number of louvers and a heat exchanger requiring a large amount of radiation has a higher ratio between the fin width and the number of louvers.

Japanese Patent Application Publication No. 10-170184 has paid attention to the shape of louvers formed on fins disposed between the tubes of heat exchangers to improve the heat exchange efficiency.

When two or more heat exchangers are disposed in parallel against a ventilating direction as mounted on a vehicle, a flow of outside air is disturbed by the heat exchanger positioned

on the windward side of the ventilating airflow. Thus, it is difficult to maintain the heat-exchanging performance of the heat exchanger positioned on the leeward side.

Specifically, as shown in Fig. 4, when the height h'c of tubes 13 of the first heat exchanger and the height h'r of tubes 14 of the second heat exchanger are equal, the speed of airflow passing through the first heat exchanger is lowered by the presence of the tubes 13 of the first heat exchanger which is disposed on the windward side and the airflow spreads out, so that the air speed is lowered along the surfaces of the tubes 14 and the fins 6 of the second heat exchanger. Consequently, the heat-exchanging performance of the second heat exchanger is significantly lowered.

To mount the heat exchangers within an engine room having a limited mounting space, the first and second heat exchangers must be placed as close as possible and be light-weighted.

Especially, when the tubes are disposed at right angles to the ventilating direction, outside air does not come into contact with the surfaces of tubes of the second heat exchanger through which a high-temperature medium flows, so that the heat-exchanging performance is lowered. Especially, when the tubes of the first and second heat exchangers have the same pitch, outside air does not flow along the surfaces of tubes of the second heat exchanger, and the amount of heat radiation of the second heat exchanger is lowered considerably.

Accordingly, it is an object of the invention to provide a composite heat exchanger which is able to keep the heat-exchanging performance of a heat exchanger disposed on the

leeward side from being lowered.

SUMMARY OF THE INVENTION

According to the invention there is provided a composite heat exchanger comprised of two or more heat exchangers which are disposed in parallel at right angles to the direction of ventilating airflow, wherein the heat exchangers each have a plurality of tubes stacked. The height of tubes of one heat exchanger disposed on the windward side is smaller than the height of tubes of the other heat exchanger disposed on the leeward side.

Thus, when the two or more heat exchangers are disposed in parallel at right angles to the ventilating direction and the height of tubes of the heat exchanger on the windward side is smaller than the height of tubes of the heat exchanger disposed on the leeward side, an airflow passes through the heat exchangers on the windward side to the surfaces of tubes of the heat exchanger on the leeward side without being disturbed by the tubes of the heat exchanger on the windward side. Thus, heat is radiated from the tubes of the leeward side through which a high-temperature medium flows, and the heat-exchanging performance of the second heat exchanger on the leeward side can be maintained.

The respective heat exchangers disposed in parallel may have substantially the same space between the stacked tubes.

For example, when the first heat exchanger and the second heat exchanger are disposed in parallel at right angles to the ventilating direction, especially when the first heat exchanger

and the second heat exchanger have the same space between the tubes which have the same height or the tubes of the first heat exchanger is higher than the tubes of the second heat exchanger, the speed of the outside air having passed through the first heat exchanger is lowered by the presence of the tubes of the first heat exchanger which is on the windward side in the ventilating direction. The outside air having passed through the first heat exchanger is spread so that its speed is lowered on the surfaces of the second tubes and the fins of the second heat exchanger, and the heat-exchanging performance of the second heat exchanger is lowered considerably.

In this embodiment, even when the first and second heat exchangers have substantially the same space between the tubes, the height of tubes of the first heat exchanger is smaller than the height of tubes of the second heat exchanger, so that the ventilation airflow is not disturbed, and the outside air is allowed to reach the surfaces of the tubes of the second heat exchanger. Thus, the heat-exchanging performance of the second heat exchanger can be maintained.

The respective tubes may have a height of less than 1.6 mm. The tubes for the heat exchanger are desired to have a height of 1.6 mm or less in view of the heat-exchanging efficiency of the heat exchanger and its weight reduction. Especially, when the first heat exchanger is a condenser, the heat-exchanging efficiency is further improved by using tubes having a height of 1.3 mm or less, and it becomes possible to make the heat exchanger more compact and light-weighted.

The two or more heat exchangers disposed in parallel have

a space of 15 mm or less between the tubes. For example, when the first and second heat exchangers are mounted in an engine room, it is desired to mount the first and second heat exchangers, which are disposed in parallel, as close as possible to each other in order to reduce a mounting space. Meanwhile, when the first and second heat exchangers are disposed adjacent to each other, the airflow to the second heat exchanger is disturbed by the first heat exchanger disposed on the windward side in the ventilating direction, and the heat-exchanging performance of the heat exchanger disposed on the leeward side in the ventilating direction is lowered.

According to the present invention, the height of tubes for the first heat exchanger disposed on the windward side is made smaller than the height of tubes for the second heat exchanger disposed on the leeward side. Therefore, the heat-exchanging performance of the second heat exchanger can be maintained even if the first and second heat exchangers are disposed as closely as a space of 15 mm between them.

One of the heat exchangers may be a condenser and the other may be a radiator. In other words, the heat exchangers to be mounted closely to each other in the engine room are often a condenser for air conditioner and a radiator for cooling an engine, respectively, both of which are required to have high heat-exchanging performance.

The two or more heat exchangers may be integrally configured using a common member. When the two or more heat exchangers are integrally configured by a common member, for example, a bracket, the heat exchangers have small weights so

that their mounting operation in the engine room is facilitated without increasing the mounting space.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a composite heat exchanger consisting of first and second heat exchangers according to an embodiment of the present invention;

Fig. 2 is a sectional view of part of the composite heat exchanger;

Fig. 3 is a graph showing a relationship between the ratio of the heights of tubes of the first and second heat exchangers and the ratio of a heat radiation amount of the second heat exchanger according to the embodiment of the invention; and

Fig. 4 is a sectional view of part of a conventional composite heat exchanger.

BEST MODE FOR CARRYING OUT THE INVENTION

As shown in Fig. 1, the composite heat exchanger has first and second heat exchangers 1, 2 which are disposed in parallel at right angles with a ventilating direction A.

The individual heat exchangers 1, 2 have a plurality of tubes 3, 4 and fins 5, 6 fitted between the tubes 3, 4 to increase the radiation area. The tubes 3, 4 and the fins 5, 6 are stacked into a plurality of layers, and each end of the tubes 3, 4 is connected to header tanks 7, 8, 9, 10. A heat-exchanging medium is distributed to flow from the respective header tanks 7, 8 to the individual tubes 3, 4 to perform heat exchange so that the high-temperature medium becomes the low-temperature medium

by radiation from the tubes 3, 4 and the fins 5, 6.

An arrow in Fig. 1 indicates the direction of an outside airflow.

The first and second heat exchangers 1, 2 are supported and integrally configured by common members. In this embodiment, common brackets 15 are used to fix the first and second heat exchangers 1, 2 with bolts. Specifically, two common brackets 15 each are disposed on the top and bottom of end plates of both heat exchangers, and bolts are inserted through each common bracket in the longitudinal direction of a vehicle. Thus, when the first and second heat exchangers are integrally configured by the common members or brackets 15, individual brackets which have been separately fitted to the respective heat exchangers can be eliminated by virtue of the common brackets. Thus, the heat exchangers can be light-weighted and mounted in an engine room with ease.

In this embodiment, the first heat exchanger 1 is a condenser for a vehicle air conditioner which is disposed on the windward side of the ventilating direction, and the second heat exchanger 2 is an engine radiator which is disposed on the leeward side of the ventilating direction.

The space K between the condenser as the first heat exchanger 1 and the radiator as the second heat exchanger 2 is set at 15 mm in order to reduce a mounting space. Especially, it is significant to reduce the mounting space in order to mount the heat exchangers on a vehicle.

Thus, when the first heat exchanger 1 and the second heat exchanger 2 are closely mounted to each other, the ventilation

by outside air is disturbed by the first heat exchanger 1 which is disposed on the windward side, and the outside air hardly flows through the second heat exchanger 2, particularly along the surfaces of the tubes 4 through which the medium flows. Thus, the desired heat-exchanging performance cannot be obtained.

Therefore, in this embodiment, the height hc of tubes of the first heat exchanger 1 which is disposed in parallel to the second heat exchanger and at right angles to the ventilating direction is made smaller than the height hr of tubes of the second heat exchanger 2.

In other words, the heights of tubes of the first and second heat exchangers which are disposed in parallel at right angles to the ventilating direction have a relation of $hc < hr$.

In Fig. 2, reference numerals 11, 12 indicate louvers formed on the fins 5, 6. The arrows in the drawing indicate the ventilating direction of outside air.

As shown in Fig. 3, the ratio of the heat radiation amount of the second heat exchanger is improved or greater than 1 when $hr/hc > 1$, namely when the height of tubes of the condenser disposed on the windward side is smaller than the height of tubes of the radiator disposed on the leeward side.

In Fig. 3, a point B indicates that the relation between the height $h'c$ of tubes of the first heat exchanger and the height $h'r$ of tubes of the second heat exchanger is $h'c = h'r$.

A Point A indicates that the relation between the heights of tubes 3, 4 of the first and second heat exchangers is $hr/hc = 1.5$ or > 1.

A Point C indicates that the relation between the heights

hr and hc of tubes of the first and second heat exchangers is $hr/hc = .75$ or < 1.

The tubes 3, 4 configuring the heat exchangers 1, 2 are desired to have a height of less than 1.6 mm considering the heat-exchanging performance and weight reduction of the heat exchangers. Particularly, when the first heat exchanger is a condenser as in this embodiment, the heat-exchanging efficiency is improved furthermore by determining the tubes to have a height of 1.3 mm or less. And, the heat exchanger can be made more compact and light-weighted.

Accordingly, the tubes 3, 4 of the heat exchangers 1, 2 are formed in this embodiment basically to satisfy the relation of $hc < hr < 1.6$ mm.

By forming the first and second heat exchangers using the tubes meeting the above inequality, the heat-exchanging performance of the second heat exchanger can be improved without increasing the mounting space.

The condenser used for the heat-exchanging cycle of a car air conditioner and the radiator for cooling an engine are disposed in an engine room in parallel at right angles to the ventilating direction.

When the tubes of the condenser as the first heat exchanger are configured to have a height smaller than the height of tubes of the radiator as the second heat exchanger as in this embodiment, the heat-exchanging performance of the second heat exchanger is not disturbed by the first heat exchanger, and the required high heat-exchanging performance can be obtained.

The composite heat exchanger according to the present

invention, which is comprised of two or more heat exchangers disposed in parallel on the windward and leeward sides, can improve the heat-exchanging performance of the second heat exchanger disposed on the leeward side, so that the composite heat exchanger can be made compact and light-weighted. Especially, the composite heat exchanger of the invention is suitable for the refrigerating cycle for a vehicle or household appliance.